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ANALYSIS OF RIVER CLEANING SHIP DESIGN USING THE TRASHER BOAT IDEA USING MAXSURF

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ABSTRACT

Ships are a means of transportation for moving materials and goods from one place to another. Along with this increase, it was also followed by the development of other industries so that it had an impact. However, in increasing these activities, in addition to generating benefits, it also creates new impacts through the waste produced. Several work boats are made to solve problems related to the type of work according to needs. The solution that can be used to overcome the accumulation of garbage in the river is to use the help of a Trash Skimmer Boat. This work boat is a type of special ship that is used to carry out waste collection in rivers, lakes, seas and canals. By using the help of Maxsurf Software, the main size is L = 100 cm, B = 30 cm H = 15 cm, T = 3.54 cm with a payload capacity of 3 kg. It has the following data: Displacement = 6,968 kg ; block coefficient (Cb) = 0.387; Prismatic Coef (Cp) = 0.832.
Keyword : Ship, Workboat, Trasher boat, Trash Skimmer Boat

ABSTRAK

Kapal merupakan salah satu alat transportasi untuk memindahkan bahan dan barang dari satu tempat ketempat lain. Seiring dengan peningkatan tersebut juga diikuti dengan perkembangan industry lain sehingga memiliki dampak. Namun dalam peningkatan aktivitas tersebut, di samping menghasilkan manfaat juga menimbulkan dampak baru melalui sampah yang dihasilkan. Beberapa work boat dibuat untuk menyelesaikan permasalahan yang berkaitan dengan jenis kerjaan sesuai dengan kebutuhan.Solusi yang dapat digunakan untuk mengatasi penumpukan sampah yang ada di sungai yaitu dengan menggunakan bantuan Trash Skimmer Boat. Work Boat ini adalah salah satu jenis dari kapal khusus yang difungsikan untuk melakukan pengambilan sampah perairan baik sungai, danau, laut, maupun kanal. Dengan menggunakan bantuan Software Maxsurf, maka diperoleh ukuran utama sebesar L = 100 cm, B = 30 cm H = 15 cm, T = 3.54 cm dengan kapasitas muatan sebesar 3 kg ini memiliki data seperti berikut: Displacement = 6.968 kg ; block coeff (Cb) = 0.387; Prismatic Coeff (Cp) = 0.832.
Kata Kunci : *Kapal, Workboat, Trasher boat, Trash Skimmer Boat*

1. Introduction

Trash Skimmer Boat is a working ship with a catamaran hull and is equipped with a conveyor belt that can be raised and lowered as needed. The conveyor belt has the function of collecting garbage that floats on the surface of the river and has a reservoir itself that functions to accommodate the collected garbage. Garbage collection is carried out through the bow side of the ship. On the bow side of the ship which serves as the entrance for garbage, there is an arm that can be moved as desired.

A watershed (DAS) is an ecosystem unit whose main elements consist of natural resources, water and vegetation. Watersheds in several places in Indonesia bear a very heavy burden due to their very high population density and intensive use of their natural resources so that there have been several indications recently that the condition of the watersheds is decreasing with indications of increasing occurrences of landslides, erosion, sedimentation, flooding and drought.

The city of Medan is crossed by 6 (six) rivers, namely: the Deli River, the Babura River, the Denai River, the White River, the Belawan River, and the Sikambing River, while the Deli river connects three regencies, namely Karo, Deli Serdang and Medan City. The river is very much needed by the community and is used for

bathing, washing and toilets as well as being a garbage disposal site. Deli River is a river that is 73 kilometers long and has an average width of 58 meters and an average depth of 8 meters.

From this, a similar study was carried out to be applied to the Deli river in North Sumatra. The Deli River is a river with a length of 73 kilometers and an average width of 58 meters and an average depth of 8 meters and empties into the Malacca Strait. Therefore, the authors designed a product with this data. By paying attention to the main issues and previous research contained in the background, this research was conducted to examine the feasibility of the technical aspects of the analysis of the design of a garbage cleaning ship, namely the main size of the ship that can be used optimally and according to the characteristics of the cruise area on the Deli river, the characteristics of the ship seen from in terms of stability, the shape of the ship line plan in accordance with the shipping area, as well as the general layout or plan of the ship.

2. Methods

This study uses a simulation method, namely by conducting a simulation to design a ship intended to transport garbage in the river. At this stage the author will determine how this product will be designed using the Maxsurf Modeller application so that it will be obtained whether the product is feasible for production or not by looking at the environment in which it operates and analyzing it with empirical calculations as a basic reference in order to determine the type of hull that can be used

1. Single hull
2. Katamaran
3. Tritamaran

After that, it will be continued by comparing the results obtained from the three hulls with the basic results produced. in this way the author can determine the type of hull that is feasible to be made by the next researcher

3. Results and Discussion

In general, the design of a product is based on the need for the product to be used. In this case the C-Ocean motor ship is designed by using the maxsurf series to get results and product calculations that make it easier for the writer to determine the feasibility of the product to be used or not. The following will show how the product will be designed and find out the important components in the design process

Design determination is also based on environmental research where the product will be used. This process is also what gives the author to choose a catamaran hull to be designed and calculated, in the design stage there are several elements that will be calculated and considered.

Table 1. River data

Part	Depth river (m)	River width (m)	Cross-sectional area (m^2)	Flow rate (m/s)
Upstream	5.88	6.4	8	1,41
	3.87	7,15	6,91	1,12
Middle	2,31	4.8	2.8	0,74
	3,56	5.87	5,23	0,51
	4,23	7.2	7,63	0,67
Down Stream	5,69	5.99	8,53	1,34
	7	7	12.25	1,6

after obtaining data from the environment that has been observed, data will be determined again through empirical calculations to obtain data which is the basis for comparison with simulation results

Table 2. Empirical Formula

formula	Result
Ship waterline formula	**LWL = LPP + (2 % x LPP)**
	LWL = 88cm + (2 % x 88cm)
	LWL = 89,76
Volum Dislplacement	**∇ = Lwl x B x T x Cb**
	∇ = 89,76cm x30cmx6,8 cm x0,38
	∇ = 6958,19 cm^3

Displacement

Δ = **Lwl x B x T x** δ **x** ρ**air**
$\Delta = \nabla$ **x** ρ
Δ **= 6,95 x** 10^{-3} m^3**x1025 kg/** m^3
Δ **= 7,132 kg**

Coefisien Block

$$CB = \frac{Vol}{LwlxBxt}$$
$$CB = \frac{6058,19}{89,76x30x6,8}$$
$$CB = 0,38$$

Coefisien Midship

Cm = 0,91 + 0,1 $\sqrt{Cb}$
Cm = 0,91 + 0,1 $\sqrt{0,38}$
Cm = 0,96

Coefisien Prismatik Formula Troast

Cp = Cb / Cm
Cp = 0,38 / 0,96
Cp = 0,395

Coefisien Waterline

Cwp = $\sqrt{Cm - 0,297}$
Cwp = $\sqrt{0,38 - 0,297}$
Cwp = 0,814

Waterline Area

Awl = Lwl x B x Cwp
Awl = 89,76 x 30 x 0,814
Awl = 2191,93 cm^2

Resistance

$$R_T = C_T x \frac{1}{2} x \rho x WSA x V_s^2$$
$$R_T = 6,125 \text{ x } 10^{-3} x \frac{1}{2} x \rho x 0,418 m^2 x 2,57^2$$
$$R_T = 8,455\ kN$$

In the next stage of the product design being studied is to calculate the main cross section of the ship (Hull) which makes the ship able to work at sea. As well as calculating how much load can be transported by the product and simplify the prototyping process

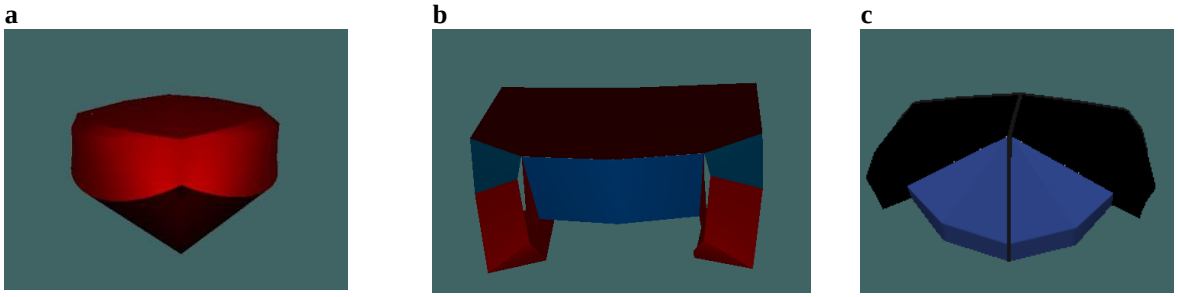

Figure 1. (a) Single Hull, (b) Katamaran Hull (c) Tritamaran Hull

In the picture above we can see that in 3D view only the hull is visible because in the next calculations in maxsurf the important thing is to calculate the resistance and stability from the data obtained in the design. To make it easier, we get the basic data as follows contained in the table

Tabel 3. Simulation Result

Formula	Single Hull	Katamaran Hull	Tritamaran Hull
Ship waterline formula	92.01 cm	89.86 cm	83.08 cm
Volum Dislplacement	5837.93 cm^3	6798.18 cm^3	8881.84 cm^3
Displacement	5.984 kg	6.968 kg	9.104 kg
Coefisien Block	0.399	0.387	0.416
Coefisien Midship	0.820	0.832	0.866
Coefisien Prismatik Formula Troast	0.487	0.465	0.484
Coefisien Waterline	0.843	0.889	0.762
Waterline Area	1856.76 cm^2	2356.44 cm^2	2327.77 cm^2

In ship simulation to determine the ratio of speed to resistance, resistance will be obtained in units of newtons to be able to reach speeds of 5 knots when the ship is loaded and when it is empty which happens to three types of hull

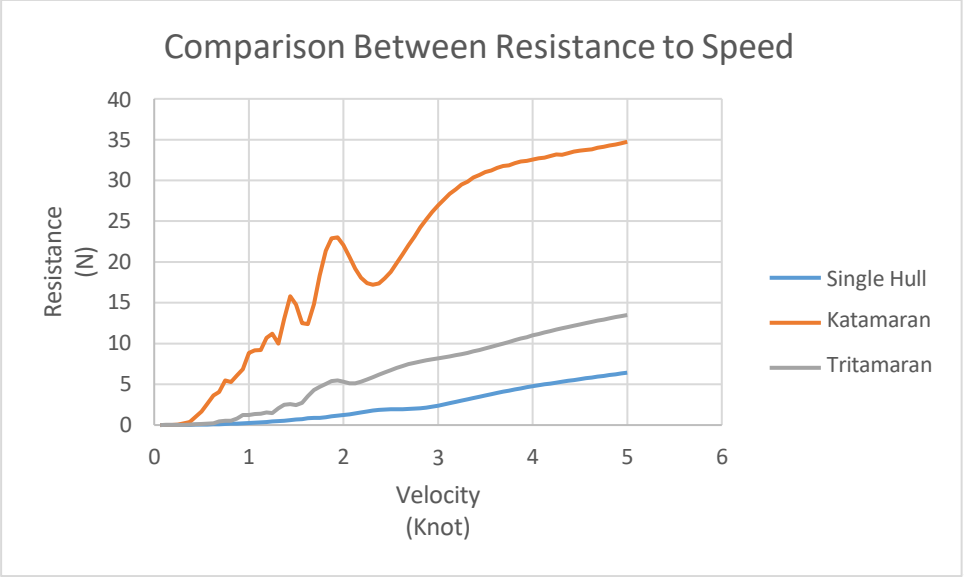

Figure 2. Resistance to Velocity

During the C-Ocean Ship simulation process using the maxsurf modeler and maxsurf resistance to find out the amount of resistance on the ship at a certain speed and find out the waveforms that are created. C-ocean ships have minimal resistance at low speeds but at speeds of 2 knots experience a significant increase in resistance. However, after that prisoners also experienced a normal increase. As for the power requirements at a speed of 5 knots the required power.

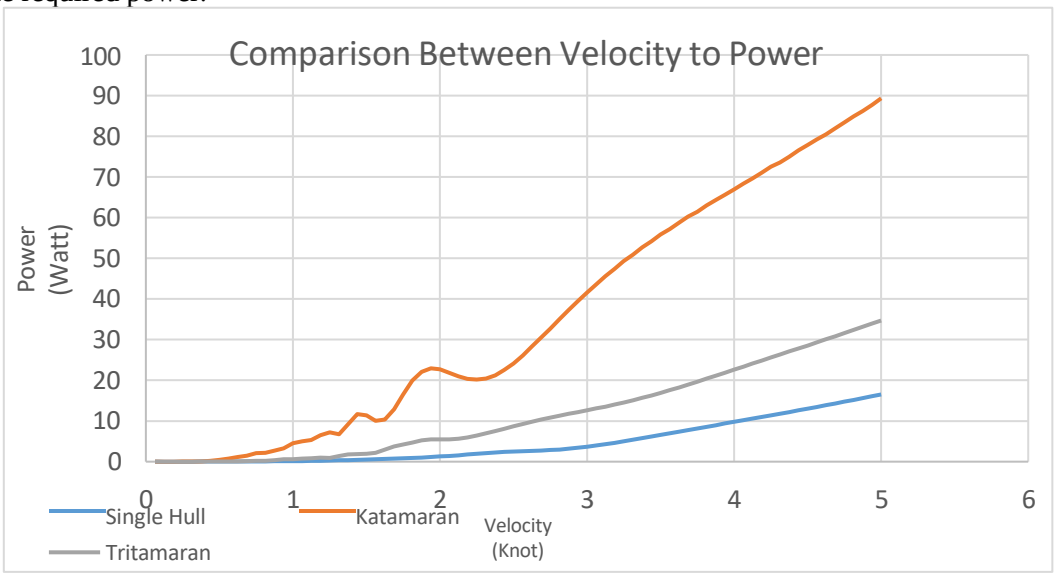

Figure 3 Velocity to Power

In the comparison of frictional force in the simulation, the C-Ocean ship experiences maximum frictional force when moving so it requires a large power when running and when the speed reaches 5 knots the friction on the water surface against the body is getting smaller but when compared the three hulls will not have a big difference significant

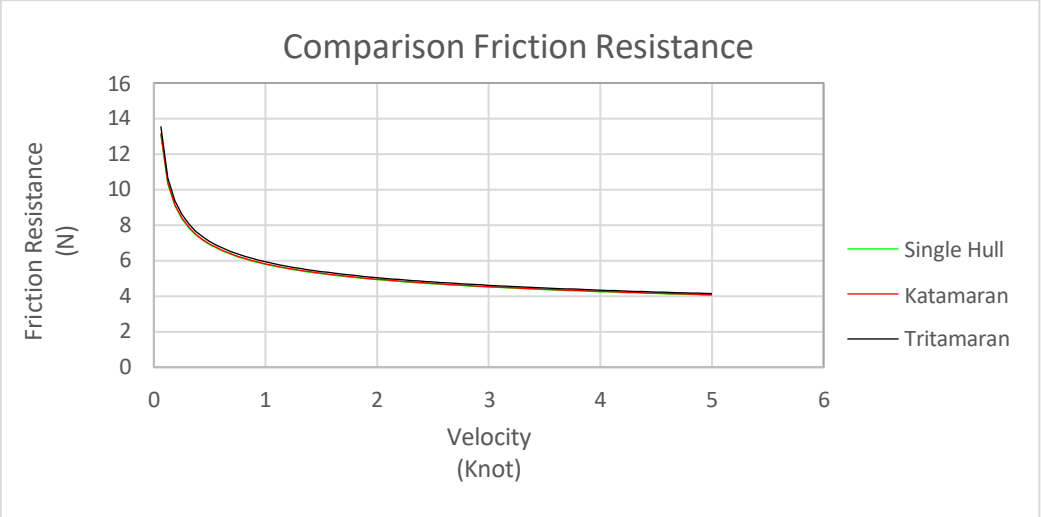

Figure 4. Friction Resistance to Velocity

4. Conclusion

1. The results of the analysis of the design of the Trasher Boat are ships that have the main dimensions of L = 100 cm, B = 30 cm, H = 15 cm, Kb = 0.38. To suit the needs of the Deli River which has field data that has been recorded. And the use of the maxsurf application to simulate the 3 types of hulls that are designed.
2. From the simulated ship the requirement is a tritamaran because in this type of hull the level of balance is high because at an angle of 60 degrees the ship is still laden but has not yet had the potential to sink, the power requirement only requires 39 watts for the power requirement to move and the ship's resistance to speed it only takes 18 newtons.
3. The application of the trasher boat technology will be optimal with the data being compared and the tritamaran hull type is obtained which is very suitable for use in its design for the needs of the river environment to carry out waste transport work and between the full weight and the recommended displacement it is very safe because it does not exceed what is designed so that the ship to be produced will work optimally

References

[1] Hutagaol, N., 2016. PENGEMBANGAN PELABUHAN BELAWAN DAN PENGARUHNYA TERHADAP KEHIDUPAN SOSIAL EKONOMI MASYARAKAT DELI, 1920-1942. J. Sej. Citra Lekha 1, 40–50.

[2] Manen, J. D., & Oossanen, P. V. (1988). Principles of Naval Architecture. In E. V. Lewis, Principles of Naval Architecture Second Revision (p. 153). Jersey City: The Society of Naval Architects and Marine Engineers.

[3] Arlius, Farendy. 2014. Tanker 5000 Payload. Rencana garis. Rencana Umum.Skripsi.Surabaya: Institut Teknologi Sepuluh November\

[4] Wulan AN. 2015. TUTORIAL MEMBUAT KAPAL MENGGUNAKAN APLIKASI MAXSURF. Universitas Brawijaya Malang

[5] Walezyk, S. L. (2016). Patent No. US20060065586A1. United States.

[6] Andriyanto RD, Manfaat D. PENENTUAN UKURAN UTAMA KAPAL OPTIMAL DENGAN METODE BASIS SHIP MENGGUNAKAN SISTEM KOMPUTER. JURNAL TEKNIK POMITS Vol. 2, No. 1, (2013) ISSN: 2337-3539 (2301-9271 Print)

[7] Karya pemuda mulyo agung, 2017, Jenis-jenis Lambung kapal lengkap dengan pengertiannya

[8] Biro Klasifikasi Indonesia. (2009). Rules for The Classification and Construction of Seagoing Steel Ships, Volume II Rules for Hull. Jakarta: Biro Klasifikasi Indonesia

[9] Harvald A. A. (1992). Tahanan Dan Propulsi Kapal. Surabaya : Erlangga

[10] Manfaat, D. (2013). Case-Based Design : Desain Berbasis Kasus. Jakarta: Gramedia Pustaka Utama.

[11] Hogben, N and Standing, R (1975), Wave Pattern Resistance Fnom Routine Model Test, Trans. RINA, Vol 117.